MAR 1952

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CENTRAL INTELLIGENCE AGENCY
INFORMATION FROM
FOREIGN DOCUMENTS OR RADIO BROADCASTS

REPORT
CD NO.

COUNTRY USSR

SUBJECT Economic; Technological - Powder metallurgy

DATE OF INFORMATION 1952

HOW PUBLISHED Monthly periodical

DATE DIST. 9 MAR 1954

WHERE PUBLISHED Moscow

NO. OF PAGES 5

DATE PUBLISHED Jun, Nov 1952

LANGUAGE Russian

SUPPLEMENT TO REPORT NO.

THIS IS UNEVALUATED INFORMATION

SOURCE As indicated

USE OF METAL CERAMIC PARTS IN USSR MOTOR VEHICLES AND TRACTORS

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WEAR RESISTANCE OF METAL CERAMIC PARTS -- Moscow, Avtomobil'naya i Traktornaya Promyshlennost', Jun 52

Metal ceramic sleeve bearings are used in the motor vehicle industry in a number of applications, including bushings for generators, starters, distributors, and water pumps; and transmission main drive gear bearing retainers.

Metal ceramic parts have high wear resistance because they are not subject to dry and semidry friction as are ordinary dense metal parts. The pores of metal ceramic parts are saturated with liquid lubricants. In addition, a solid lubricant, graphite, is one of the structural elements of metal ceramic compounds.

The character of wear of metal ceramic parts is no different from that of dense metal parts, but there is less wear because the metal ceramic parts have a lower coefficient of friction. For example, the coefficient of friction of metal ceramic lead bronze (copper, 70.5 percent; lead, 29 percent, and graphite, 0.5 percent) is 0.006-0.007, while the coefficient of friction of cast bronze is 0.008-0.009. The coefficient of friction of metal ceramic bronze-graphite and iron-graphite materials containing 0.5 to 3.0 percent graphite is 0.005-0.008.

To save metal, a method of making bimetallic metal ceramic bushings has been developed. This produces a firm bond between the metal layers of the bushing. The outer layer of the bimetallic bushing is made of porous iron. The inner layer is made of metal ceramic bronze of the following composition: 87 percent copper, 3 percent graphite, and 10 percent tin. Porosity of the iron layer is 25-30 percent, and porosity of the inner bronze-graphite layer is 20-25 percent. The wear of a bimetallic water pump bushing after a run of 38,000 kilometers was 0.02-0.03 millimeters.

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Use of a bronze-graphite metal ceramic bushing in the M-72 motorcycle reduced wear four to six times as compared with ordinary bushings. Wear on the upper and lower head-tube bushings of a motorcycle after a run of 9,000 kilometers was as follows:

Bushing	Metal Ceramic(mm)	Aluminum-Bronze(mm)
Upper	0.220-0.260	0.980-1.300
Lower	0.205-0.240	1.230-2.275

After 270 hours of operation, a set of diesel engine connecting rod bushings lined with metal ceramic bronze lost only 0.4342 grams of metal through wear, while cast bronze bushings lost 0.5451 grams of metal in the same period of time. V. V. Saklinskiy, Orgavtoprom (All-Union State Institute of Motor Vehicle Technology)

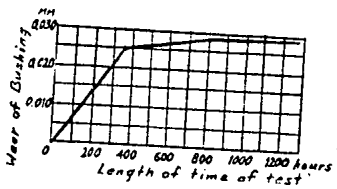
METAL CERAMIC MOTOR VEHICLE AND TRACTOR PARTS -- Moscow, Avtomobil'naya i Traktornaya Promyshlennost', Nov 52

The following article was also written by V. V. Saklinskiy.

Metal ceramic materials are most widely used in the motor vehicle and tractor industry for antifriction parts (see items 1-8 in appended graphics material), friction facings (item 9), and washers (item 10).

Antifriction parts have the following percentages of component metals: Parts with an iron base -- 91-99 percent iron, 1-4 percent graphite, and 0-5 percent copper; parts with a copper base -- 86-94 percent copper, 5-10 percent tin, and 4 percent graphite, or 60-70 percent copper, 40-50 percent lead, and 0.5-2.0 percent graphite. Porosity of metal ceramic parts is 15-30 percent.

The following graph shows the results of tests carried out with 11 iron-graphite tractor bushings.

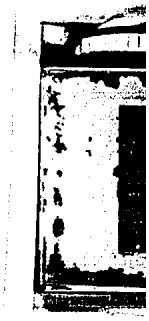


Wear of Metal Ceramic Bushings Used on the DT-54 Tractor

The coefficient of friction of cast lead bronze is 0.007, while that of metal ceramic bronze is 0.005.

The chief shortcoming of metal ceramic parts is their low mechanical strength, caused by the porosity of the material and nonmetallic inclusions (graphite).

For parts subjected to heavy loads, bimetallic bearings, consisting of a steel back with a lining of antifriction metal ceramic material, are used. Production of bimetallic bearings consists of the following operations: preparing the powder mixture, applying it to the steel back, sintering the uncompressed mixture on the steel back in a protective gas atmosphere, pressing the presintered lining, high sintering, and mechanical processing (stamping, punching holes, and machining.



In making the metal ceramic parts described in this article, metal scrap amounts to only 3-5 percent, as compared to 35-45 percent scrap from ordinary production methods. The specific density of metal ceramic parts is also 20-30 percent less than that of ordinary parts.

The labor consumption of a mass-produced metal ceramic part weighing 120 grams is 13 man-hours per thousand parts, as compared to 100 man-hours per thousand for dense metal parts.

Metal powders are more costly than dense metals; for example, iron powder is 1.67 times as expensive, copper - 3.35, tin - 1.30, and lead - 3.78. However, the cost of material consumed in making metal ceramic parts is only slightly greater than the cost of dense metals [because less material is wasted in machining].

Metal ceramic friction materials are made by adding to the powder mixture silicon dioxide, asbestos, ferric oxide, or other materials which increase the coefficient of friction.

Metal ceramic parts can be made with a coefficient of friction as high as 0.7 for dry friction and 0.25 for wet friction. The absence of organic binders increases the heat resistance of these parts to at least 540 degrees centigrade as compared with 140-160 degrees centigrade for ordinary materials. There is considerably less wear of metal ceramic friction materials because of their superior mechanical properties.

Porous metal ceramic materials (with 15-60 percent porosity) may be used to make washers, seals, and filters. Metal ceramic parts may be made from waste metal such as filings resulting from the grinding and sharpening of metals. It takes 250 kilograms of rolled steel to make 60 kilograms of bearing nuts by ordinary methods. However, the same quantity of nuts can be made from steel scrap alone by powder metallurgical methods.

The table below gives the results of tests on a number of metal ceramic parts:

Name of Part	Vehicle	Results of Test
Thrust bearing cage bushing	Pobeda	Process now being used in production
Bearing insert with metal ceramic underlayer (thin-walled)	GAZ-51	Stand tests showed a 300 percent increase in durability
TsKB-740 cage	--	Withstood 1,000 hours of stand testing (calculated life of cage is 250 hours)
Metal ceramic piston rings	Pobeda	Wear of rings and cylinder cut in half
Head-tube bushing	M-72 motorcycle	12 times as strong as a textolite bushing
Tightening nut for the bushing of the 11205 bearing	--	Costs half as much as a nut made from 1020 steel
Bimetallic bushing for water pump	Moskvich	Bronze consumption is one third that of a bronze-graphite bushing.

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